**Citation:**

Berkey CS, Rockett HRH, Field AE, Gillman MW, Frazier AL, Camargo CA, Colditz GA. Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. *Pediatrics* 2000; 105: 1-9.

**PubMed ID:** 10742377

**Study Design:**

Prospective Cohort Study

**Class:**

B - Click here for explanation of classification scheme.

**Research Design and Implementation Rating:**

POSITIVE: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

To examine the role of physical activity, inactivity, and dietary patterns on annual weight changes among preadolescents and adolescents, taking growth and development into account.

**Inclusion Criteria:**

Children of nurses from the Nurses' Health Study II.

**Exclusion Criteria:**

- Child with height > 3 standard deviations beyond gender- and age-specific mean height & consecutive annual heights if height declined by > 1 inch or increased by > 8 inches between 1996 and 1997.
- Any child with BMI < 12 kg/m and any BMI > 3 SD beyond gender- and age-specific mean.
- Consecutive BMIs were excluded if they produced an annual change > 3 SD beyond the mean change.

**Description of Study Protocol:**

Children from all over US who were 9-14 in 1996 -all returned questionnaires in the fall of 1996 and a year later in 1997. Each child provided his or her current height and weight and a detailed assessment of typical past-year dietary intakes, physical activities, and recreational inactivities (TV< videos/VCR & video/computer games).

**Data Collection Summary:**

**Dependent Variables**

Annual changes in adiposity – 1 year change in BMI (from 1996 to 1997) (height & weight

reported by children).

**Independent Variables**

- Dietary Intake: Total Caloric Intake, Total Fat Intake, Total Association of Official Analytical Chemists Dietary Fiber Intake (Self-administered semiquantitative food frequency questionnaire);
- Physical Activity: Hours of p.a. (outside of gym class) per week & # of gym or physical education classes in school per week (physical activity questionnaire);
- TV/Videos/Games: Weekly hours of recreational inactivity (series of questions).

**Control Variables**

- Race/ethnic group,
- baseline BMI,
- annual change in height,
- menstrual history in girls,
- Tanner stage,
- age

1 year change in BMI was adjusted for time lag between the 2 returned questionnaires (not always exactly 12 months); fat & fiber intakes were energy-adjusted. All analysis performed separately by gender.

**Statistical Analysis**

Linear Regression Model

**Description of Actual Data Sample:**

**Original Sample:** 8980 girls & 7791 boys at baseline (who were within ages 9-14 years.

**Withdrawals/Drop-Outs:** adolescents who did not return questionnaire & exclusions due to missing values on one or more important variables.

**Final Sample:** 6149 girls and 4620 boys from all over the US who were 9 to 14 years old in 1996.

**Location:** US

**Race/Ethnicity:** 94.7% were white (not Hispanic), .9% were black (not Hispanic), 1.5% were Hispanic, 1.5% Asian & 1.4% other (including Native American).

**SES:** not specified.

**Age:** 9-14 years

**Summary of Results:**

**Accuracy of FFQ**

The accuracy of the FFQ used in this study did not vary according to the BMI or age.

**Increase in BMI**

Girls who were 11 y.o. at baseline and boys who were 12 y.o. had the largest mean annual increase in BMI.

**Multivariate analyses**

For both boys & girls, a larger rise in caloric intake from 1996 to 1997 predicted larger BMI increases (girls: .0059 + .0027 kg/m2 per increase of 100 kcal/day; boys: .0082 + .0030).

No significant associations were noted for energy-adjusted dietary fat or fiber.

**Physical Activity**

For both girls and boys there was a significant ($p<.001$) positive association between BMI and hours per day of TV/Videos/Video games.

For girls, there was a weak though significant ($p<.046$) negative association between general physical activity (hours per day) and increase in BMI. The relationship for boys was not significant ($p<.094$)

For neither boys nor girls was there a significant association between the number of gym classes per week and change in BMI.

**Author Conclusion:**

The results of this study provide evidence that, in older children and adolescents, energy intake, physical activity, and recreational inactivity are associated with changes in body fatness, but that dietary fat and fiber are not (aside from their energy content). Attempts by pediatricians to modify each of several factors a little, rather than modifying a single factor (activity, TV/videos/games or energy intake) a lot, might be more successful in individual patients.

***Reviewer Comments:***

***Strengths***

- *Longitudinal design.*
- *Large sample size.*

***Limitations***

*Self-reported height & weight.*

---

***Research Design and Implementation Criteria Checklist: Primary Research***

| **Relevance Questions** | | |
|---|---|---|
| 1. | Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies) | N/A |

| | | |
|---|---|---|
| 2. | Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about? | Yes |
| 3. | Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice? | Yes |
| 4. | Is the intervention or procedure feasible? (NA for some epidemiological studies) | N/A |

**Validity Questions**

| | | |
|---|---|---|
| **1.** | **Was the research question clearly stated?** | Yes |
| 1.1. | Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified? | Yes |
| 1.2. | Was (were) the outcome(s) [dependent variable(s)] clearly indicated? | Yes |
| 1.3. | Were the target population and setting specified? | Yes |
| **2.** | **Was the selection of study subjects/patients free from bias?** | Yes |
| 2.1. | Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study? | Yes |
| 2.2. | Were criteria applied equally to all study groups? | N/A |
| 2.3. | Were health, demographics, and other characteristics of subjects described? | Yes |
| 2.4. | Were the subjects/patients a representative sample of the relevant population? | Yes |
| **3.** | **Were study groups comparable?** | N/A |
| 3.1. | Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT) | N/A |
| 3.2. | Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline? | N/A |
| 3.3. | Were concurrent controls used? (Concurrent preferred over historical controls.) | N/A |
| 3.4. | If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis? | N/A |

| | | |
|---|---|---|
| 3.5. | If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.) | N/A |
| 3.6. | If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")? | N/A |
| **4.** | **Was method of handling withdrawals described?** | Yes |
| 4.1. | Were follow-up methods described and the same for all groups? | N/A |
| 4.2. | Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.) | Yes |
| 4.3. | Were all enrolled subjects/patients (in the original sample) accounted for? | No |
| 4.4. | Were reasons for withdrawals similar across groups? | N/A |
| 4.5. | If diagnostic test, was decision to perform reference test not dependent on results of test under study? | N/A |
| **5.** | **Was blinding used to prevent introduction of bias?** | Yes |
| 5.1. | In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate? | N/A |
| 5.2. | Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.) | Yes |
| 5.3. | In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded? | Yes |
| 5.4. | In case control study, was case definition explicit and case ascertainment not influenced by exposure status? | N/A |
| 5.5. | In diagnostic study, were test results blinded to patient history and other test results? | N/A |
| **6.** | **Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?** | Yes |
| 6.1. | In RCT or other intervention trial, were protocols described for all regimens studied? | N/A |
| 6.2. | In observational study, were interventions, study settings, and clinicians/provider described? | Yes |
| 6.3. | Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect? | Yes |
| 6.4. | Was the amount of exposure and, if relevant, subject/patient compliance measured? | Yes |

| | | |
|---|---|---|
| 6.5. | Were co-interventions (e.g., ancillary treatments, other therapies) described? | N/A |
| 6.6. | Were extra or unplanned treatments described? | N/A |
| 6.7. | Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups? | N/A |
| 6.8. | In diagnostic study, were details of test administration and replication sufficient? | N/A |
| **7.** | **Were outcomes clearly defined and the measurements valid and reliable?** | Yes |
| 7.1. | Were primary and secondary endpoints described and relevant to the question? | Yes |
| 7.2. | Were nutrition measures appropriate to question and outcomes of concern? | Yes |
| 7.3. | Was the period of follow-up long enough for important outcome(s) to occur? | Yes |
| 7.4. | Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures? | No |
| 7.5. | Was the measurement of effect at an appropriate level of precision? | Yes |
| 7.6. | Were other factors accounted for (measured) that could affect outcomes? | Yes |
| 7.7. | Were the measurements conducted consistently across groups? | N/A |
| **8.** | **Was the statistical analysis appropriate for the study design and type of outcome indicators?** | Yes |
| 8.1. | Were statistical analyses adequately described and the results reported appropriately? | Yes |
| 8.2. | Were correct statistical tests used and assumptions of test not violated? | Yes |
| 8.3. | Were statistics reported with levels of significance and/or confidence intervals? | Yes |
| 8.4. | Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)? | N/A |
| 8.5. | Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)? | Yes |
| 8.6. | Was clinical significance as well as statistical significance reported? | Yes |
| 8.7. | If negative findings, was a power calculation reported to address type 2 error? | N/A |
| **9.** | **Are conclusions supported by results with biases and limitations taken into consideration?** | Yes |
| 9.1. | Is there a discussion of findings? | Yes |

| | | |
|---|---|---|
| 9.2. | Are biases and study limitations identified and discussed? | Yes |
| **10.** | **Is bias due to study's funding or sponsorship unlikely?** | Yes |
| 10.1. | Were sources of funding and investigators' affiliations described? | Yes |
| 10.2. | Was the study free from apparent conflict of interest? | Yes |